# PURDUE UNIVERSITY INSTITUTE FOR CANCER RESEARCH

**Pioneering basic research** AGAIN, AND AGAIN, AND AGAIN

ANNUAL REVIEW 2022

#### ANDREW MESECAR

Walther Professor in Cancer Structural Biology Interim Director, Purdue Institute for Cancer Research

## JACQUELINE LINNES

Marta E. Gross Associate Professor of Biomedical Engineering After almost 45 years of groundbreaking multidisciplinary cancer research, the Purdue Center for Cancer Research is changing its name to the

# Purdue Institute for Cancer Research.

**The elevation of the Purdue Center** for Cancer Research to a universitylevel institute signals its high priority within our research ecosystem,"

says Theresa Mayer, former executive vice president for research and partnerships.

As one of only seven National Cancer Institutedesignated basic laboratory cancer centers in the U.S., the institute generated more than 150 patents during the past decade and its members have more than 40 drugs in various stages of development. Purdue Institute for Cancer Research members currently have 11 drugs in clinical trials and have had three drugs approved by the Food and Drug Administration in 2022.

The name change reflects decades of continual growth and diversification of the institute's efforts to improve cancer diagnosis, treatment and care through basic, cellularlevel research. Multiple cancer technologies have been pioneered at Purdue to improve the clarity of magnetic resonance imaging, detect sensitivities to chemotherapy and illuminate cancer cells during surgery to ensure complete cancer removal. ◊

#### **BACK TO THE BENCH**

# Timothy Ratliff steps down as institute's director

In another life, Timothy Ratliff would have been a park ranger.

He was studying bird migration patterns while pursuing a graduate degree in field biology at Texas A&M University-Commerce when, in the span of six months, his father died of malignant melanoma and his father-inlaw died of prostate cancer. Neither cancer had any effective treatments at the time and both men endured difficult deaths.

"I hung up my boots, put on a lab coat and changed my direction," Ratliff says. "I've been working in cancer research ever since."

Ratliff stepped down from his role as the Robert Wallace

Miller Director of the Purdue Center for Cancer Research in June after leading the organization for 15 years. He remains on faculty in the College of Veterinary Medicine's Department of Comparative Pathobiology as a distinguished professor and continues as an active member of the Cancer Institute.

Established in 1976, the Purdue Institute for Cancer Research was among the first interdisciplinary research groups at the University. It's one of only seven NCIdesignated basic cancer centers in the country, a prestigious status the institute has maintained since 1978.

A world-renowned expert

in developing treatments for bladder and prostate cancers, Ratliff was recruited to lead the institute in 2007 from the University of Iowa, where he was a professor of prostate cancer research, research vice chair of the Department of Urology and leader of the Immunology and Immunotherapy Program for the Holden Comprehensive Cancer Center. His vision at the time was to make the organization more translational, to move more drugs toward the clinic and engage researchers at a higher level.

"The Cancer Institute draws members from seven colleges and 23 departments across campus," Ratliff says. "We have strength in the diversity of expertise among our faculty. The institute integrates their fundamental disciplines to address important questions in cancer research."

Under Ratliff's leadership, the Cancer Institute cemented its status as one of the nation's leading institutions in drug development. Member scientists have 37 new drugs in the pipeline, including 11 currently in human clinical trials and 26 new immunotherapies in development. Member researchers' intellectual property also has led to the creation of 16 companies during the past 10 years and numerous patents have been licensed by existing or newly formed companies.

ßĜ

The foundation is laid for the institute to be even greater than it is now."

Accelerating the timeline of drug development is the goal of Boilermaker Health Innovations, a nonprofit corporation Ratliff cofounded with Philip Low, the Presidential Scholar for Drug Discovery and Ralph C. Corley Distinguished Professor of Chemistry. Launched by the University, Boilermaker Health aims to provide funding to translate new drugs into clinical trials.

"We have really streamlined the drug development process," Ratliff says. "Purdue has a lot of exceptional chemists on campus, but it was challenging to move their compounds into testing. Boilermaker Health solves that issue. It is a tremendous resource to push our most promising drugs to clinic."

Ratliff was principal investigator on the clinical trials for a Purdue's first FDA-approved drug, a precision targeted therapy to treat prostate cancer developed by Low. The pair partnered together to raise funding for the clinical trials and move the drug through the "valley of death" – the pharmaceutical industry's term for the stages from discovery to clinical development where many preclinical findings meet their demise.

He also championed DESI (desorption electrospray ionization) mass spectrometry, a technology used to detect cancerous cells invented at Purdue by a team led by R. Graham Cooks, and helped pave the way for its commercialization.

In addition to numerous scientific advancements

during his tenure, Ratliff also solidified the financial footing of the organization by growing its endowment from around \$500,000 when he first arrived to more than \$40 million today.

"The Walther Cancer Foundation has been very supportive in providing matching gifts," Ratliff says. "The general philanthropy of individuals has also been tremendous. The collaborations among our diverse faculty are fueled by grant support."

Though Ratliff is stepping down, he is not slowing down. He intends to devote more time to his own research in immunotherapy. He also hopes to have more time for outdoor activities such as hiking, kayaking and mountain climbing, which have remained his avocation over the years.

It was the caliber of the faculty that first attracted Ratliff to Purdue and as he reflects on the past 15 years, it's the strength of collaboration that marks his legacy as director.

"I just hope people see that we made advances and that we made a difference," Ratliff says. "That the foundation is laid for the institute to be even greater than it is now."  $\diamond$ 



#### TIMOTHY L. RATLIFF

Distinguished Professor of Comparative Pathobiology

#### HONORING DR. RATLIFF

Or. Timothy Ratliff served as only the fourth director of the Purdue Institute for Cancer Research over its 45-year history and undoubtedly faced the institute's biggest challenges as cancer research largely progressed from yeast and mouse models to model systems derived from human patient cells and tissues.

From his first arrival on campus, he set forth with a strong determination and vision to lead the institute and its outstanding basic scientists into the future of cancer research where he was unwaveringly confident they would make major scientific advances for the betterment of cancer patients. From the engagement of IU physicians, to outreach to Purdue engineers, he led the charge that resulted in the current success of the institute."

*—Marietta Harrison,* professor emerita of medicinal chemistry and molecular pharmacology



Ratliff with a graduate student in 2007.

My husband, Dick, and I were pleased to support the Purdue Institute for Cancer Research and help cure cancer. The Robert Wallace Miller Directorship was named after our son who died of rhabdomyosarcoma stage II. Dr. Ratliff's passion for cancer is immeasurable and inspiring. During his tenure, he was especially good at being able to translate research to a level that was easily understood. Tim, and his wife, Jackie, will always be associated with the success of the institute and his leadership will be missed. Our family is forever intertwined with Purdue, too. Our son, Rick (technology 1980), served on the institute's Director's Advancement Board. Dick graduated in 1963 and our daughter, Pam, is studying at Purdue Global.

#### –Jane K. Miller,

benefactor of the Robert Wallace Miller Director of the Purdue Cancer Center



My career at the Cancer Institute began in August 2010 working with Dr. Ratliff. In January 2012, I was diagnosed with pancreatic cancer.

When I shared my diagnosis with Dr. Ratliff, he immediately reached out to the Indiana University Simon Cancer Center. My journey of surgery, chemotherapy, radiation and immunotherapy began, which has given me more than 10 years cancer free and the hope of many more.

The sincerity that Dr. Ratliff revealed wasn't only for me. It is evident in the many lives he touched during his time as director of the institute. I have been truly blessed in so many ways over the last 12 years to have worked in the cancer institute with Dr. Timothy Ratliff. His leadership will be greatly missed by us all."

> *—Michelle Liratni,* Cancer Institute senior administrative assistant



Ratliff on the summit of Mt. Fuji in 2011.

Tim is an inspiring mentor and active collaborator for both my scientific research and academic leadership at Purdue. Tim was one of the several senior faculty colleagues who supported the significant undertaking of expanding my research interest from tissue engineering to cancer. I have been fortunate to experience and learn from his academic leadership and the care he shows toward his colleagues, staff members and students.

#### -Bumsoo Han,

professor of mechanical engineering and biomedical engineering and program leader for the Cancer Institute "Tim has been not only an outstanding leader of the Cancer Institute, but also an excellent scientist, colleague and collaborator. When we first discovered how to target imaging and therapeutic agents to prostate cancer cells, Tim recognized the potential of our method and suggested that we test its cancer targeting specificity by evaluating its ability to image prostate cancer tissue in human patients. I was skeptical that we could achieve such a complicated task at Purdue University, but Tim not only designed a plan and raised the funding, but also organized the project and recruited the doctors at Indiana University School of Medicine to conduct the clinical trial. The resulting very impressive images motivated all of our subsequent work that ultimately led to development of Pluvicto, a prostate cancer therapy that should revolutionize the treatment of prostate cancer for years to come."

#### —Philip Low,

Presidential Scholar for Drug Discovery and the Ralph C. Corley Distinguished Professor of Chemistry



After Tim's arrival as director, the Cancer Institute was elevated not only in funds raised but also in visibility. The Challenge 5k, the institute's signature annual event, began under Tim's leadership and has annually increased funding and awareness across campus and the community. The institute would not be where it is today without Tim's leadership and vision.

*—Linda Rohrman,* past chair of the Director's Advisory Board

CC "Tim Ratliff has proven himself not only to be a terrific person but also a great leader. His representation of the institute is one of the reasons we decided to make and commit to completing our pledge. We are delighted that he will remain with the institute doing his outstanding research."

*—Norm '65 and Karen '65 Blake,* Purdue Institute for Cancer Research supporters

#### CANCER RESEARCH ON CAMPUS

Purdue Institute for Cancer Research is a basic research center, but what does that mean? The National Cancer Institute (NCI) identifies four broad categories of cancer research:



#### **BASIC RESEARCH**

Basic research seeks to understand the fundamental aspects of nature. It provides the foundation for advances against cancer.

#### **CLINICAL RESEARCH**

Clinical research tests drugs, medical devices or other intervention in human volunteers to improve all aspects of patient care.





#### **POPULATION-BASED RESEARCH**

Population-based research explores the causes of cancer, cancer trends and factors that affect the delivery and outcomes of cancer care in specific populations.

#### **TRANSLATIONAL RESEARCH**

Translational research moves basic research finding into the clinic and clinical research findings into everyday care. In turn, results from clinical and populationbased studies can guide basic research.



The Cancer Institute is an NCIdesignated basic research center. This is why cancer research thrives on Purdue's campus.

This kind of work requires drive, curiosity, and collaboration — all characteristics that define Boilermakers. It requires faculty researchers from seven colleges and 23 departments to work together, each bringing their own unique skills for

## **ONE COMMON GOAL**

#### to cure cancer.



## Why is Basic Research Important?

Basic research provides the raw materials for tomorrow's scientific and technical advances. It increases our knowledge and understanding of nature and its laws.





**Brittany Allen-Petersen** Assistant Professor, Department of Biological Sciences

The Allen-Petersen lab studies the impact of phosphatase deregulation on tumor initiation and progression, with a specific focus on KRAS-driven pancreatic cancer.

## **CELL IDENTITY & SIGNALING**

This research group within the Cancer Institute seeks to make discoveries in areas such as:

- Cell growth
  Cell migration
- Cell division
  Gene migration

This team consists of faculty researchers from:

Animal Sciences Basic Medical Sciences Biochemistry Biological Sciences Comparative Pathology Computer Science Food Science Health & Life Sciences Medicinal Chemistry & Molecular Pharmacology Nutrition Science Statistics

#### CANCER RESEARCH ON CAMPUS



**Yoon Yeo** Associate Department Head, Industrial and Physical Pharmacy

Yeo's lab develops new drug delivery systems — such as nanoparticle surface engineering to solid tumors — with a focus on cancer immunotherapy.

#### Why is Basic Research Important?

Basic research requires painstaking attention to detail and often involves an iterative approach, meaning that individual projects can often span periods of months or years. But without basic research, it would be impossible to develop new ways to prevent and treat cancer.

### **DRUG DELIVERY & MOLECULAR SENSING**

This research group within the Cancer Institute seeks to make discoveries in areas such as:

- Drug delivery
- Imaging cancer during surgery
- Tumor models to study cancer biology

This team consists of faculty researchers from:

Biomedical EngineeringHChemical EngineeringHChemistryMComparative PathobiologyMElectrical & Computer EngineeringH

Health Sciences Industrial & Physical Pharmacy Mechanical Engineering Nutrition Science Physics & Astronomy





## **TARGETS, STRUCTURES & DRUGS**

This research group within the Cancer Institute seeks to make discoveries in areas such as:

- Molecular-level understanding of cancer biology
- Therapeutics to clinical application
- Identifying cancer targets

This team consists of faculty researchers from:

Basic Medical Sciences Biochemistry Biological Sciences Chemistry Comparative Pathobiology Computer Science Health Sciences Medicinal Chemistry & Molecular Pharmacology Organic Chemistry Veterinary Clinical Sciences

Herman Sintim Richard B. Wetherill Professor of Chemistry and Drug Discovery

Integrating computational and experimental workflows, Sintim's research group has identified novel chemotypes of kinase inhibitors for the potential treatment of recurrent cancers.

## Why is Basic Research Important?

Findings from basic research, such as studies of cancer cells in the laboratory, can ultimately define research questions to study in humans, such as helping to identify drugs to test in clinical trials.

#### PIONEERING BREAKTHROUGH

## UNIVERSITY'S FIRST FDA-APPROVED DRUG GUIDES SURGICAL RESECTION OF CANCER LESIONS

An accidental discovery nearly 40 years ago paved the way for Purdue's first FDA-approved targeted cancer therapy.

Philip Low, the Presidential Scholar for Drug Discovery and the Ralph C. Corley Distinguished Professor of Chemistry, was studying plant cells when he discovered that the vitamin biotin could act as a Trojan horse, carrying attached molecules into plant cells.

"The question arose, is there anything similar that would carry attached drugs into animal cells," Low says. "To make a long story short, we found that folate did the same thing, but only in cancer cells."

Marketed with the brand name Cytalux, the new drug uses folic acid to target a fluorescent imaging agent to cancerous cells, causing them to glow brightly under nearinfrared light.

"Those lesions light up like stars against a night sky," says Low, an inventor of the drug. "The healthy tissue can remain dark, so it's very easy for the surgeon to locate and resect the cancerous tissue."

The drug, which received initial approval from the FDA in November 2021, was approved in December 2022 for treatment of lung cancer under the FDA Fast Track designation, a process meant to expedite the review of important drugs to fill an unmet medical need. In clinical trials, Cytalux helped lung surgeons find malignant lesions that otherwise would have gone undetected in 57% of patients.

"The surest cure for cancer is surgical resection," Low says. "That's why these tumor-targeted fluorescent dyes are so valuable, they help achieve the goal of quantitative removal." ♦

#### PHILIP LOW

Fmet

Presidential Scholar for Drug Discovery and the Ralph C. Corley Distinguished Professor of Chemistry

#### TRANSFORMATIONAL GIVING



#### SURPRISE \$8.5 MILLION ESTATE GIFT WILL FUND MORE THAN 40 YEARS OF CANCER RESEARCH

Thanks to an unexpected bequest of \$8.5 million from fellow faculty member John Capaldi, Philip Low, Purdue University's Presidential Scholar for Drug Discovery and the Ralph C. Corley Distinguished Professor of Chemistry, has funding to support more than 40 years' worth of cancer research.

"I was absolutely knocked off my feet when I found out what was in his estate," Low says. "These funds have come at a perfect time for my lab, in that we have been blessed with many good ideas on how to treat cancer but have been short on the funding to develop them. Over my 40-year career, I've taken the time to record my very best ideas, and with this remarkable gift from Dr. Capaldi, I won't have to delay exploring them anymore."

When Capaldi, professor emeritus of psychological sciences at Purdue, lost his only sister to cancer, he told his attorney that when he died, he wanted his remaining assets to support cancer research. His attorney, who had known of Low since high school, recommended supporting Low's research.

When Capaldi died in November 2020, he left much of his estate, including a Purdue-funded retirement account, to Low's lab at Purdue.

Much of the funding for Low's lab comes from federal grants, which require precise proposals for how the funding will be used. While these funds are vital, private gifts — like that from Capaldi — mean Low can pursue discoveries as they arise, allowing nimble and time-sensitive discoveries that wouldn't otherwise be possible. In this area, he'll apply a question that he considers key: "How can I use this information to do something that really matters?"

"I found that simply asking that question can open up opportunities that I would have never envisioned had I not stopped to think about the potential value to humanity of the work that I was doing," Low says. "I do believe I have an obligation to minimize the suffering of cancer patients if I can."  $\diamond$ 



John Capaldi Professor Emeritus of Psychological Sciences





#### NIGHT OF HOPE

Zeta Tau Alpha invited all participants of the Big Man on Campus fundraising campaign to attend A Night of Hope on February 9, 2022, at the Hansen Life Science Research Building.

Event attendees heard from cancer survivors and Purdue researchers who are advancing the fight against cancer.

Through the Big Man on Campus fundraiser, the sorority raises \$25,000 annually for the Cancer Institute and has donated over \$1.5 million to the institute since the event's founding in 1996.



#### CHALLENGE 5K

The 14th Annual Challenge 5k run/walk took place on April 9, 2022. This race is the Cancer Institute's largest fundraiser each year, and brings together Purdue University faculty, staff, students, student-athletes and the community. The Challenge has generated more than \$1 million for lifesaving cancer research at Purdue since 2008.

Mark your calendar for the 15th Annual Challenge 5k on April 15, 2023.









#### TEE OFF FOR TYLER

The second annual Tee Off for Tyler Charity Golf Classic took place on June 6, 2022 at The Bridgewater Club in Carmel, Indiana.

The event brought together over 200 golfers and volunteers. The Purdue Institute for Cancer Research was honored to be a beneficiary of this fundraiser.

Tony '91 and Kelly Trent, parents of Tyler Trent '19, presented Andy Mesecar, interim director of the Purdue Institute for Cancer Research, with a \$25,000 check from the Tyler Trent Foundation.



#### B U Z Z - A - B E T A

Beta Theta Pi held its third annual Buzz-A-Beta philanthropy event in October 2022, to benefit the Tyler Trent Cancer Research Endowment.

Fifty members of the fraternity volunteered to have their heads shaved, raising \$55,000 through donations and sponsorships.

#### INSPIRING CONTINUED SUPPORT



The Walther Cancer Foundation is a private grant-making foundation, based in Indianapolis, that supports and promotes interdisciplinary and inter-institution cancer research at the Purdue Institute for Cancer Research and similar institutions. The foundation has invested almost \$184 million in cancer-focused research, including more than \$20 million in research grants to the Purdue Institute for Cancer Research.

Purdue Institute for Cancer Research support from Walther includes a \$10 million matching funds gift — established in 2017 — which the institute raised in only three years.

In part, this gift was designed to inspire those who are leading the fight against cancer to give endowed gifts in support of the institute and its groundbreaking research.

# \$10 MILLION

## IN MATCHING GIFTS

The Walther Cancer Foundation has enjoyed a longstanding partnership with the Purdue Institute for Cancer Research. We were thrilled that Purdue raised \$10 million in only three years. It's a testament to the collaborative efforts of Tim Ratliff and all he has accomplished during his time as director."

-Tom Grein, President & CEO, Walther Cancer Foundation

**228 NEW ENDOWMENTS** *created through the matching gifts program* 





Members of the Walther Cancer Foundation Board stand with Tom Grein (second from right), president and CEO of Walther; and Tim Ratliff (far right), former director of the Purdue Institute for Cancer Research; in the atrium of the Purdue University Hansen Life Sciences Research Building. In October 2021, the space was named in recognition of the partnership between Walther and the Cancer Institute.

# OUR NEXT GIANT LEAP

The Walther Cancer Foundation established an additional \$11 million matching funds gift in support of bioinformatics — using computer technology to analyze and interpret biological data. The funds will be shared between Purdue University and Indiana University. Walther has already distributed \$4.7 million with \$2.35 million going to Purdue — and intends to distribute the full \$11 million by June 30, 2024.

Please contact Brandt Patz, chief development officer, at 765-494-6230 or bapatz@purdueforlife.org for more information about this new matching gift program.



Awards distributed for both the fiscal years 20-21 and 21-22 more than doubled award amounts from previous years. This impact is the tangible effect of our generous supporters partnering with the Walther Cancer Foundation's commitment of \$10 million in matching funds, which have been fully pledged. We are very excited to see the additional impact made by Walther's new matching gift program for bioinformatics research on campus.

ŝ





Hansen Life Sciences Research Building, Room 141 201 South University Street West Lafayette, IN 47907-2604 765-494-9129

Institute for Cancer Research

#### PURDUE.EDU/CANCER-RESEARCH